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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th Street, S.W.
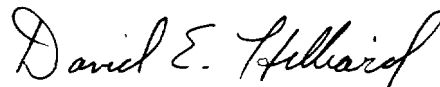Washington, DC 20554

BY HAND

Re: ***Ex Parte* Notification**
ET Docket No. 98-153
Ultra-Wideband

Dear Ms. Salas:

This is to note that on June 7, 2001, Michal Freedhoff and Paul Withington of Time Domain Corporation, Phillip Inglis, a consultant to Time Domain, and Robert Pettit of this firm and I met with Tom Tycz, John Martin, Rosalee Chiara, Rockie Patterson, and Chris Murphy of the International Bureau We addressed the issues covered in the enclosed presentation pertaining to ultra-wideband.

Should any questions arise concerning this matter, please contact me.

Respectfully,

David E. Hilliard
Counsel for Time Domain Corporation

Enclosure: Presentation
cc: Ms. Chiara, Messrs. Tycz, Martin, Patterson, and Murphy

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THE PULSE OF THE FUTURE

UWB:
The 50 MHz Limit
&
Noise-likeness

Discussion Outline

▶ The 50 MHz Limit as presently proposed

  ▶ What problems are created for the UWB industry by the 20 dB limit

  ▶ Objective of the limit

  ▶ Restrictive 20 dB limit in NPRM

  ▶ Impact on UWB Technology

  ▶ An appropriate peak limit

  ▶ A 41 dB limit is a good balance

▶ Defining sufficient noise-likeness

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Objective of the Peak-to-Average Limit

▶ The 20 dB peak limit as measured in a 50 MHz bandwidth was proposed as a means of controlling peak level interference

▶ Limits peak pulse amplitude thereby controlling peak-related interference potential

  ▶ Prevents front-end overload in a victim receiver
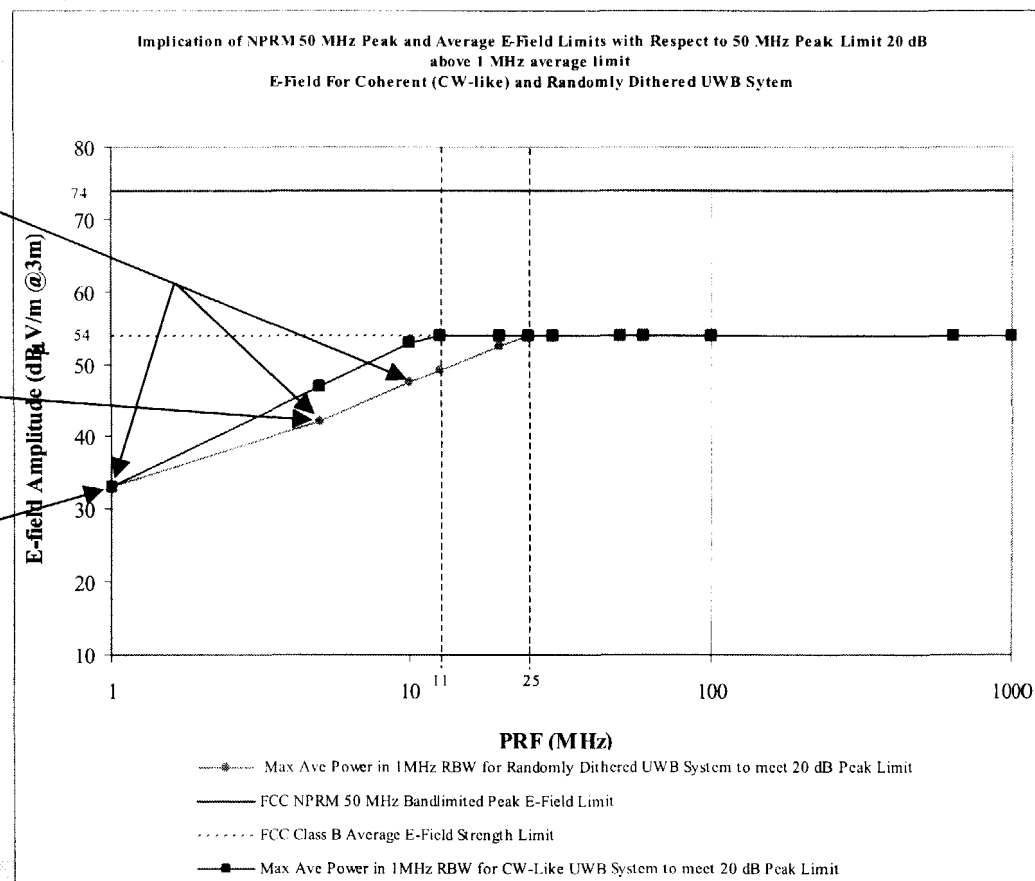
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The 50 MHz Limit

▶ As proposed in the NPRM, the lower the PRF, the lower the reduction in average power has to be

TM-UWB Emitter PRFs Used for Texas GPS Testing

TDC Through-Wall Radar PRF & PRF of Emitter Used by TDC for Its GPS Test

Typical GPR PRF & Used in Texas Testing

Implication of NPRM 50 MHz Peak and Average E-Field Limits with Respect to 50 MHz Peak Limit 20 dB above 1 MHz average limit
E-Field For Coherent (CW-like) and Randomly Dithered UWB Sytem

E-field Amplitude (dBµV/m @3m)

80
74
70
60
54
50
40
30
20
10

1   10 11   25   100   1000

PRF (MHz)

------●------ Max Ave Power in 1MHz RBW for Randomly Dithered UWB System to meet 20 dB Peak Limit

———— FCC NPRM 50 MHz Bandlimited Peak E-Field Limit

· · · · · · · FCC Class B Average E-Field Strength Limit

——■—— Max Ave Power in 1MHz RBW for CW-Like UWB System to meet 20 dB Peak Limit

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Impact of the 20 dB limit on UWB Technology

▶ Using NTIA's Pulse Response Formulas, average power reductions can be calculated.

   ▶ For dithered UWB technology, PRFs below 23-25 MHz are affected. For example, a 1 MHz PRF system would require a 21 dB reduction in average power.

   ▶ For non-dithered technologies, PRFs below 11 MHz are affected. For example, a 1 MHz PRF system would require a 21 dB reduction in average power.

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20 dB Value on 50 MHz Peak Limit is Problematic

▶ Restricts use of lower PRF systems

▶ Radar Applications – most are precluded

  ▶ TDC's radar vision - (e.g., through-wall sensing)

    ▶ Requires lower PRF for maximum range

    ▶ Severe average power reduction is required

  ▶ GPR in general has similar problems

▶ Applications also constrained

  ▶ TDC's tracking system

  ▶ Inventory monitoring

  ▶ Medical communication & tracking applications

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Problems (cont'd)

▶ Restricting UWB applications to high PRFs may increase potential impact on GPS

    ▶ GPS studies conclude that pulse-like signals (where PRF is smaller than RBW) are less of a problem for GPS than white noise or noise-like UWB signals.

    ▶ Lower PRFs are more pulse-like than higher PRFs

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Derivation of an Appropriate Peak Limit

▶ NTIA did not account for the proposed 20 dB peak to average limit and its effect on average power in its non-GPS report.

▶ NTIA did not reduce the average powers of the UWB systems tested, and as a result, the 1 MHz PRF systems actually had peak power levels that were 41 dB above the average limit.

▶ For 1 MHz PRF systems, dithered and non-dithered UWB signals evoke the same response level in a 50 MHz measurement bandwidth.

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Comments on NTIA's Average Power Analysis

▶ NTIA analyzed 15 non-GPS systems in the 1-6 GHz range for average UWB power susceptibility.

▶ PRFs below 1 MHz generally showed a 10 dB higher interference potential

  ▶ A 10 dB/decade reduction in average power for UWB PRFs below 1 MHz will equalize average power interference potential for PRFs over the 0.001 MHz to 500 MHz range.

  ▶ A 41 dB peak limit forces this 10 dB/decade reduction in average power below 1 MHz PRFs, negating the 10 dB higher interference potential noted by NTIA.

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NTIA Criteria Not Exceeded Using a 41 dB Limit

▶ Implementing an average power reduction for low PRF systems based on a 41 dB peak to average ratio, and incorporating an additional path loss figure, shows that UWB devices operating at − 41.3 dBm EIRP power levels will not exceed the protection criteria NTIA used in its analysis.

Comments on NTIA's Peak Power Analysis

▶ Of the 15 non-GPS systems examined by NTIA, 2 communications systems were further analyzed based on UWB peak power susceptibility.

▶ NTIA used a 1 dB increase in the system noise floor as its criterion for harmful interference in lieu of the the industry standard C/I ratio criterion.

   ▶ For the SARSAT station, NTIA calculated a minimum separation distance of 11.3 km for a 1 MHz PRF UWB power level of -41.3 dBm

   ▶ For the FSS Earth Station (5° elevation), NTIA calculated a minimum separation distance of 10.1 km for a 1 MHz PRF UWB power level of -41.3 dBm

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Peak Power Analysis for SARSAT and FSS Using the Industry C/I Ratio

▶ First, calculate the path loss:
  ▶ Lp=C/I-C+Pt+Gt+Gr-Ls-Lr-FDR
  ▶ Source: NTIA Report 94-313 "Analysis of electromagnetic compatibility between radar stations and 4 GHz fixed-satellite Earth stations", July 1994

▶ Then, solve for D, the minimum separation distance, using the Hata model for urban environments
  ▶ Lp=32.4+20logF+20logD

▶ When parameters for SARSAT and FSS systems given in NTIA reports and FCC proposed limits for UWB power levels for a 1 MHz system are used, the required separation distance is only 5 meters for SARSAT and 26 meters for FSS!

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Peak-Related Interference Results Comparison

NTIA non-GPS Criterion   Industry Standard Criterion

 SARSAT – 11.3 km   SARSAT – 5 m

  FSS – 10.1 km   FSS – 26 m

▸ NTIA'S analysis used incorrect performance criterion (raising noise floor by 1 dB vs. industry standard C/I ratio).

▸ NTIA Report 94-313 related to radar interference did use the industry standard approach

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Other Factors That Further Reduce the Impact of UWB

▶ Worst-case calculation by NTIA that led to the 10.2 and 11.3 km distances assumed an undithered UWB signal.

▶ Worst-case calculation by NTIA that led to the 10.2 and 11.3 km distances assumed UWB height of 30m – this only makes sense if the UWB device were indoors, which adds further attenuation.

▶ NTIA assumed that the SARSAT and FSS antennas were aimed at the UWB source – no correction for off-axis antenna alignment.

▶ At low elevation angles, FSS systems would also detect radar signals that would likely be at higher powers than UWB is proposed to be.

Consumer Satellite Services
in the 2 TO 2.5 GHZ Band

▶ NTIA Technical Memorandum 92-154 shows emissions in the 2310 to 2360 MHz band
  ▶ Radars
  ▶ Microwave ovens
  ▶ ISM-band industrial equipment
▶ "Above 2350 MHz, the probability is high that the BSS receiver will detect microwave oven pulses consistently above its threshold in any of its intended operating environments."
▶ "Below 2350 MHz, pulse amplitudes are lower, but still above the threshold at short distance in a home or between apartments."
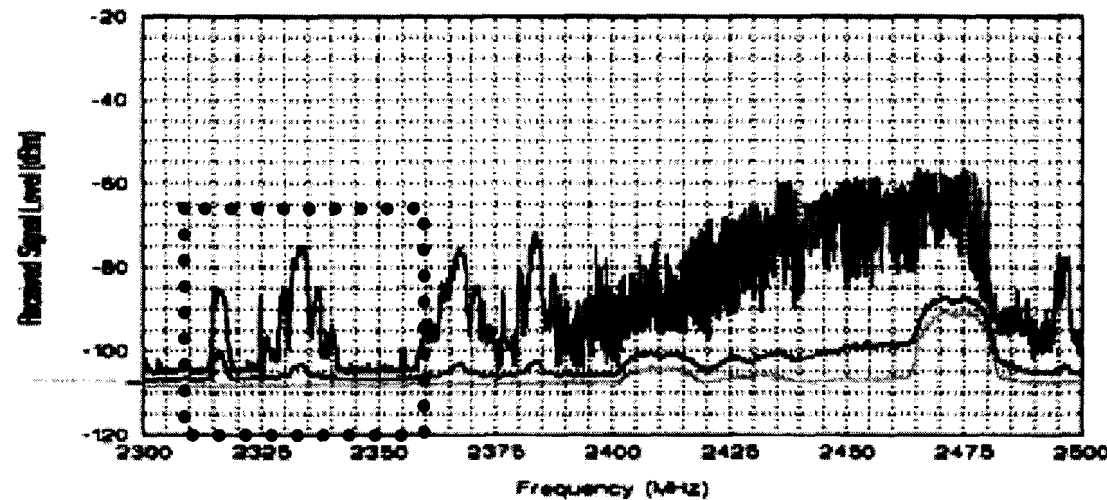
Source: NTIA Broadband Survey of San Diego, CA

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Emissions from Microwave Ovens

▶ Another NTIA report emphasizes the noise level in the 2310 to 2360 MHz band
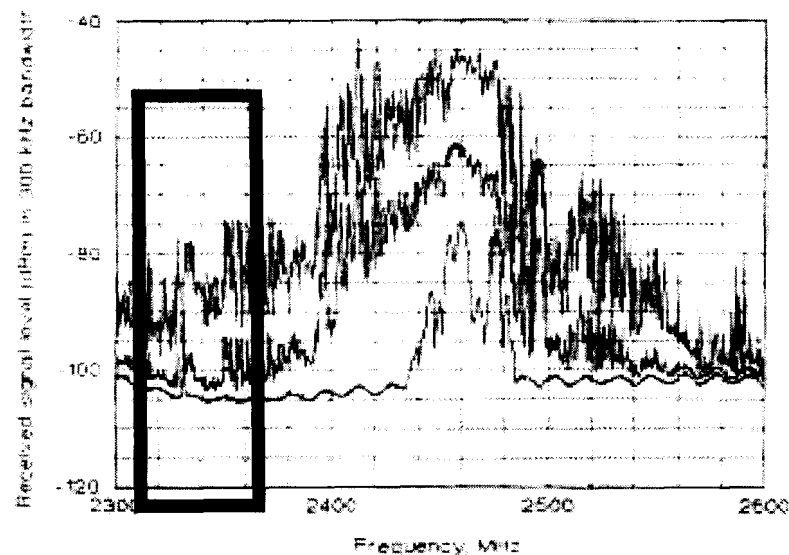

Figure 3-11. Aggregate emission spectrum outside apartment complex
4:30 -7:30 PM weekday

Source: NTIA Technical Memorandum 92-154

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Noise-likeness

▶ Time Domain believes that a test for UWB noise-likeness makes sense.

▶ A properly designed UWB signal is like, but not identical to, white noise.

▶ Using too narrow an RBW favors high PRF systems

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Conclusion

▶ A 41 dB peak to average limit poses no interference threat, and allows for the deployment of a wide range of UWB applications.

▶ Peak power effects reported by NTIA for SARSAT and FSS are incorrect and overstated.

▶ A test for noise-likeness should be applied carefully.

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